

# Wellhead Protection Area Delineation

## **4.0 WELLHEAD PROTECTION AREA DELINEATION**

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One of the elements addressed by the Idaho Wellhead Protection Program is delineation of wellhead protection areas. Wellhead protection areas are defined as the surface and subsurface area surrounding a water well or wellfield through which contaminants are likely to move and reach the well or wellfield. Within these areas, potential sources of contamination should be inventoried and managed.

The Technical Task Force and the Wellhead Protection Work Group have developed the following policies related to wellhead protection area delineation.

### **4.1 WELLHEAD PROTECTION AREA GOALS**

#### **4.1.1 Background**

Goals for the Idaho Wellhead Protection Program, and therefore the goals for wellhead protection areas, must be established so that appropriate and consistent methods will be selected. Three general goals are listed in the EPA Technical Assistance Document, "Guidelines for Delineation of Wellhead Protection Areas", that may be relevant to defining the delineation of wellhead protection areas. These three goals are as follows:

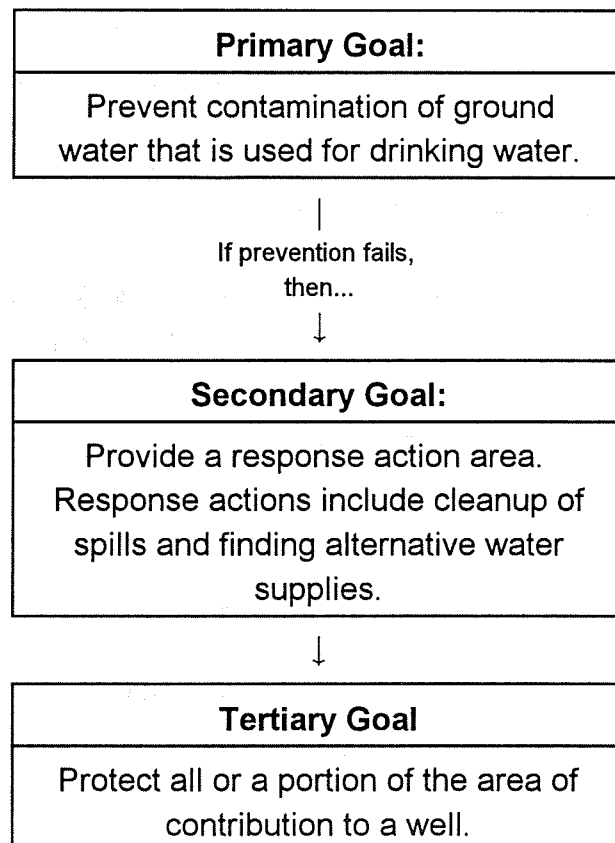
- ◆ Protect all or a portion of the area of contribution to a well;
- ◆ Provide a response action area to protect wells from unexpected contaminant releases; and
- ◆ Provide an area to allow attenuation of the concentrations of specific contaminants to desired concentrations by the time they reach the wellhead.

The delineation of wellhead protection areas alone cannot meet the goals of the wellhead protection program. This task must be combined with the other program components, such as source inventory and source management, to meet the overall goal of wellhead protection.

#### **4.1.2 State Goals**

Using the guidelines provided by the EPA, the Technical Task Force and the Wellhead Protection Work Group established a hierarchy of three goals for the Idaho Wellhead Protection Program. The wellhead protection goals for Idaho are outlined in Figure 4.1.

**Figure 4.1. Wellhead Protection Goals for Idaho**



The primary goal for the Wellhead Protection Program and wellhead protection areas in Idaho is to prevent the contamination of ground water that is used for drinking water. Prevention actions include implementing Best Management Practices (BMPs), using local ordinances, and providing public education or ground water protection.

A secondary goal is to provide a response action area. Response actions would be used when prevention is not always feasible or fails to address existing contamination problems. Response actions include ensuring adequate time to respond to a spill, cleaning up existing or new contamination problems, modifying BMPs if necessary, ensuring adequate time to install water treatment, finding interim and/or alternate sources of water supplies, and determining the area at risk.

The last goal selected by the Wellhead Protection Work Group is to protect all or a portion of the area of contribution to a well.

Attenuation of the concentrations of specific contaminants was not chosen as a goal for the Idaho program.

#### **4.1.2.1 Rationale/Discussion**

One of the policies established by the Idaho Ground Water Quality Plan (1992) is to prevent contamination of ground water from all regulated and non-regulated sources of contamination to the maximum extent practical (Policy II - A). The rationale for this policy is that the prevention of contamination is generally much less costly than cleanup, complete cleanup often is impossible, and the ground water may be impaired on a long term basis.

The Idaho Wellhead Protection Program is an implementation tool of this policy; therefore, it should follow that the primary goal for the program is to prevent contamination of ground water that is used as drinking water. Contamination can result from both point and non-point sources such as landfills, underground storage tanks, hazardous waste sites, septic tanks, storm water runoff, fertilizer and pesticide application, and underground injection wells. Prevention implies using proactive measures to keep ground water from becoming contaminated from all point and non-point sources.

Because prevention of ground water contamination is not always feasible, or there may be existing contamination problems, a secondary goal for wellhead protection areas is to provide a response action area. Contamination problems within any wellhead protection area should be a priority for cleanup to prevent water quality impacts at the wellhead. Also, if necessary, the wellhead protection area should ensure adequate time to respond to a release, treat the water, or find other sources of drinking water before the actual wellhead is impacted.

The last goal is to protect all or a portion of any area of contribution to a well. Protection of these land areas around wellheads will focus mainly on pollution prevention and education efforts.

## **4.2 TYPES OF WATER SUPPLIES**

### **4.2.1 Background**

Water wells supplying a public water supply system need to be identified so it is understood which water wells are relevant to the Wellhead Protection Program.

Protection of public water supply wells is only a minimum requirement of a state Wellhead Protection Program. Broad program goals could include protection of non-public wells

## 4.2.2 Water Supplies Relevant to the Idaho Wellhead Protection Program

The Idaho Wellhead Protection Program applies to both public and non-public water supplies.

Public water supplies include:

- ◆ community wells or springs;
- ◆ non-community, non-transient wells or springs; and
- ◆ non-community, transient wells or springs.

Non-public water supplies include:

- ◆ non-public wells (such as a private home) and
- ◆ non-public springs.

Table 4.1 outlines the different types of drinking water supplies, the Idaho definition, and the intent of the Wellhead Protection Program for that supply type.

**Table 4.1 Drinking Water Supply Types in Idaho**

Water Supply Type	Idaho Definition	Intent of the Wellhead Protection Program
Public: Community	Public water systems that serve 15 connections or 25 of the same persons year round.	Appropriate wellhead protection area delineation, guidance, and education.
Public: Non-community, non-transient	Public water systems that are not community systems and that regularly serve at least 25 of the same individuals over 6 months of the year.	Appropriate wellhead protection area delineation, guidance, and education.
Public: Non-community, transient	Public water systems that serve a transient population, such as campgrounds, rest stops, or restaurants.	Appropriate wellhead protection area delineation, guidance, and education.
Non-public	Water systems that do not meet the public water system definition. These systems serve 25 or fewer people and serve 14 or fewer connections.	Guidance and education.

### 4.2.2.1 Rationale/Discussion

Since community and non-community, non-transient wells or springs serve the same population regularly for at least 6 months per year, it is important to protect the water quality for both acute and chronic health risk reasons. Non-community, transient

wells/springs should also be protected from contamination primarily for acute health risk reasons.

Non-public water wells are not regulated by the Idaho Rules for Public Drinking Water Systems. These types of wells serve approximately one-third of the state population as a year round source of drinking water (Idaho Department of Water Resources Water Use Database, May 1991; U.S. Census, 1990). Since non-public water wells serve a significant portion of the state population and are not regulated, these wells have been included in the plan with an emphasis on providing guidance and education for non-public well owners.

### **4.3 DELINEATION OF WELLHEAD PROTECTION AREAS**

Wellhead protection areas are to be defined based on all reasonably available hydrogeologic information on ground water flow, recharge, discharge, and other information the State deems necessary.

#### **4.3.1 Background**

The system size distribution and drinking water violation data were two major factors that helped form the delineation guidelines. The intent was to develop guidelines that communities could attain and that would meet the goals of the program.

##### **4.3.1.1 System Size**

As of 1996 there were 2,499 regulated water systems in Idaho. Eight hundred thirty two (832) of these systems were community water systems, 304 were non-community, non-transient water systems, and 1,363 were non-community, transient water systems (Table 4.2).

**Table 4.2 Regulated Water Systems in Idaho**

Water System Type	Number of Water Systems	Population Served
Community	832	871,000
Non-community, non-transient	304	133,000
Non-community, transient	1,363	177,000
<b>TOTAL</b>	<b>2,499</b>	<b>1,181,000</b>

Source: DEQ Drinking Water Information Management System (DWIMS)

The sizes of the non-transient regulated systems are quite diverse: the majority of these systems (83%) serve less than 500 people each, 16% of the systems serve between 500 - 10,000 people each and 1% of the systems serve greater than 10,000 people each. It is important to note, however, that the larger systems serve a large percentage of the state population (Table 4.3).

**Table 4.3 Sizes of Regulated Community and Non-Community, Non-Transient Systems in Idaho**

Population per System	Number of Systems	Population Served
0 -100	562 (49%)	32,000 (3%)
101 - 500	389 (34%)	96,000 (10%)
501 - 10,000	183 (16%)	377,000 (40%)
> 10,000	12 (1%)	448,000 (47%)
<b>TOTAL</b>	<b>1,136</b>	<b>953,000</b>

#### 4.3.1.2 Drinking Water Violation Data

A summary of the "Maximum Contaminant Level" and "Monitoring and Reporting" bacteriological violations in 1995 indicate that a majority of the violations occurred with the smaller drinking water systems (Tables 4.4 and 4.5).

**Table 4.4 Bacteriological Compliance Report - Contaminant Violations in 1995**

<b>Bacteriological Compliance Statistics Report Contaminant Violations, 1995</b>				
<b>System Population Size</b>	<b># Violations</b>	<b># of Systems With Violations</b>	<b>% of Total Violations</b>	<b>Potential Population Affected*</b>
< 500	328	236	83.7	26,478
500 - 3,300	52	36	13.3	38,726
3,301 - 10,000	11	7	2.7	38,565
≥ 10,000	1	1	0.3	50,000
<b>TOTAL</b>	<b>392</b>	<b>280</b>	<b>100</b>	<b>153,769</b>

\*Numbers based on entire system affected Source: DEQ - DWIMS

**Table 4.5 Bacteriological Compliance Report - Monitoring and Reporting**

<b>Bacteriological Compliance Statistics Report Monitoring and Reporting Violations, 1995</b>				
<b>System Population Size</b>	<b># Violations</b>	<b># of Systems With Violations</b>	<b>% of Total Violations</b>	<b>Potential Population Affected*</b>
< 500	1941	951	93.5	89,520
500 - 3,300	102	61	4.9	85,820
3,301 - 10,000	20	11	1	62,063
≥ 10,000	12	3	0.6	55,116
<b>TOTAL</b>	<b>2,075</b>	<b>1,026</b>	<b>100</b>	<b>292,519</b>

\* Numbers based on entire system affected. Source: DEQ - DWIMS

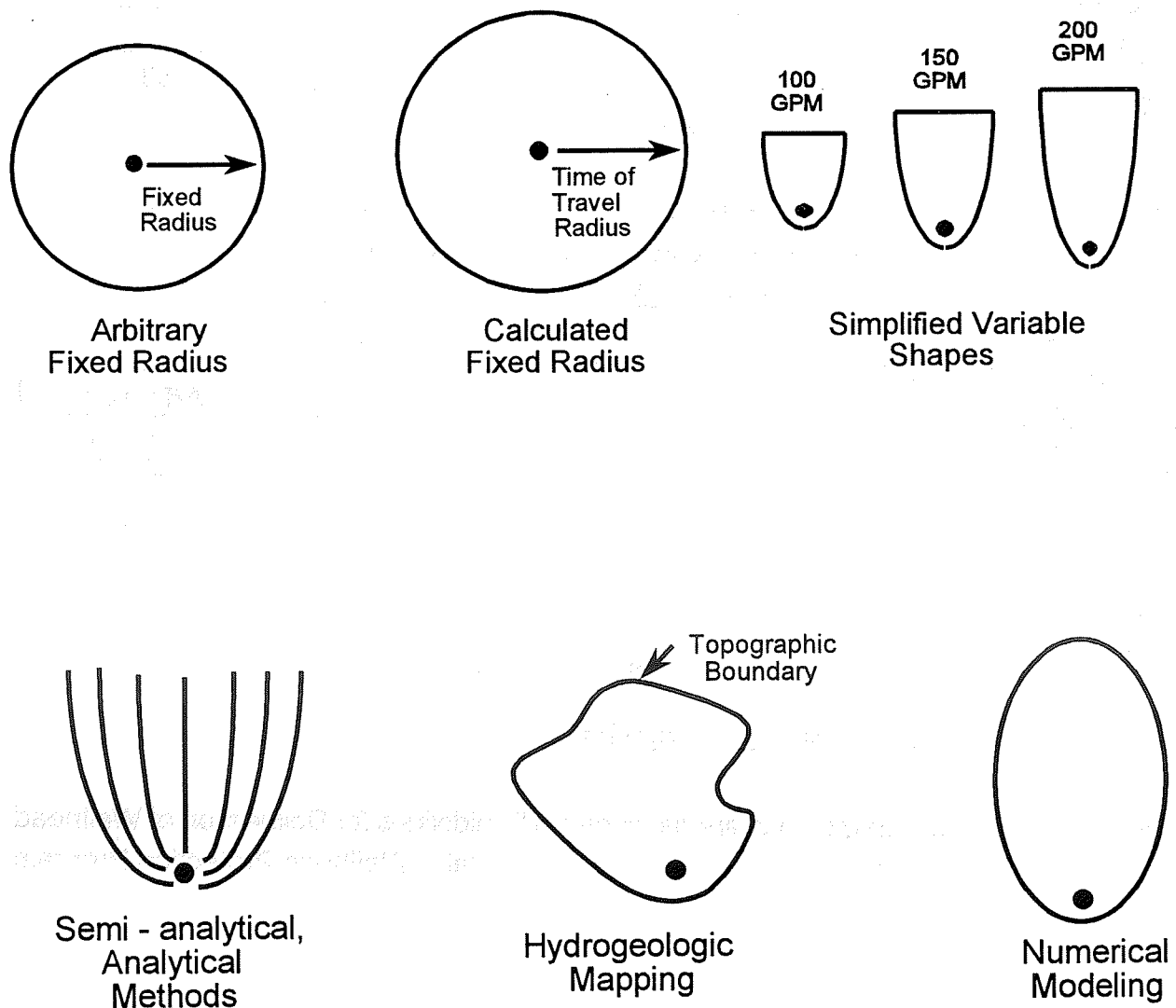
#### **4.4 DELINEATION METHODS - OVERVIEW**

The following delineation methods are described in "Guidelines for Delineation of Wellhead Protection Areas" and were considered for use in the Idaho Wellhead Protection Program (Figure 4.2):

- ◆ Arbitrary Fixed Radius;
- ◆ Calculated Fixed Radius;
- ◆ Simplified Variable Shapes;
- ◆ Analytical Methods;
- ◆ Hydrogeologic Mapping; and
- ◆ Numerical Flow/Transport Models.

All methods except arbitrary fixed radius and simplified variable shapes have been incorporated in the delineation approaches for the program. The advantages and disadvantages of the methods are discussed in some of the following sections.

**Figure 4.2. Overview of Delineation Methods**



#### **4.4.1 Arbitrary Fixed Radius**

The delineation of a wellhead protection area using the arbitrary fixed radius method involves drawing a circle around a well using an arbitrarily selected distance. This method is easily implemented, easily understood, inexpensive, and the data requirements are minimal. The major disadvantage is the degree of uncertainty due to the lack of scientific basis for the selection of the selected distance.

#### **4.4.2 Calculated Fixed Radius**

The delineation of a wellhead protection area using the calculated fixed radius involves drawing a circle for a specified time of travel threshold. The time of travel is calculated assuming that the particle of contamination is present in the aquifer.

This method is more accurate than the arbitrary fixed radius method as it is based on some scientific reasoning. The method has limitations, but can provide a low cost, easily understood, and easily applied method when site specific data are limited.

#### **4.4.3 Simplified Variable Shapes**

The simplified variable shape method uses "standardized forms" that are generated using analytical models that use flow boundaries and time of travel criteria. A "standardized form" is selected for hydrogeologic and pumping conditions similar to the wellhead of interest. The standard form is then oriented around the well according to the direction of ground water flow. The data input requires basic hydrogeologic properties and well pumping rates.

This method can be easily implemented once the standard forms are established. However, if data are lacking, then an appropriate form can not be confidently developed.

#### **4.4.4 Analytical Methods**

Analytical methods use equations to define the area of contribution to a pumping well in a sloping water table. Site specific hydrogeologic properties are required and can include transmissivity, porosity, hydraulic gradient, hydraulic conductivity, and saturated thickness of the aquifer.

The method uses equations that take into account site specific hydrogeologic properties, thus the accuracy is much greater than the arbitrary fixed radius, calculated fixed radius, and fixed shapes methods. This method can take into account hydrologic boundaries, but

implementation can be expensive if site specific data must be collected. The use of this method also requires more technical expertise.

#### **4.4.5 Hydrogeologic Mapping**

Wellhead protection areas can be mapped using geological, geophysical, isotope assessments, or dye tracing methods. Flow boundaries are defined by lithologic variation or permeability contrasts within the aquifer. This method is best suited for hydrogeologic settings dominated by near surface flow boundaries and for anisotropic aquifers, such as fractured bedrock. However, the disadvantage is that the method requires technical expertise to make judgement on what constitutes likely flow boundaries.

#### **4.4.6 Numerical Flow/Transport Models**

Wellhead protection areas can be delineated using computer models that approximate ground water flow or solute transport equations numerically. This method is especially useful where boundary and hydrogeologic conditions are complex and if site specific data are available. The method offers a potential high degree of accuracy, but can be expensive and requires hydrogeologic and modeling expertise.

### **4.5 DELINEATION APPROACHES IN IDAHO**

#### **4.5.1 General Description**

Idaho has chosen a tiered delineation approach in consideration of the wide distribution of system sizes, the drinking water violation data, and in consideration of the factors that support developing a voluntary program, as discussed in Chapter 2. These factors also were the basis for the philosophy of the program, which especially applies to the delineation component of the program. The philosophy was to develop a flexible and simple program such that implementation at the local level could be attainable, the program could be administered with limited resources, and public education would be emphasized (Figure 4.3).

**Figure 4.3. Philosophy of the Idaho Wellhead Protection Program**

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Program should be flexible and simple  
so that implementation can be  
attainable.



Program must be able to be  
administered with limited resources.



Program should emphasize public  
education.

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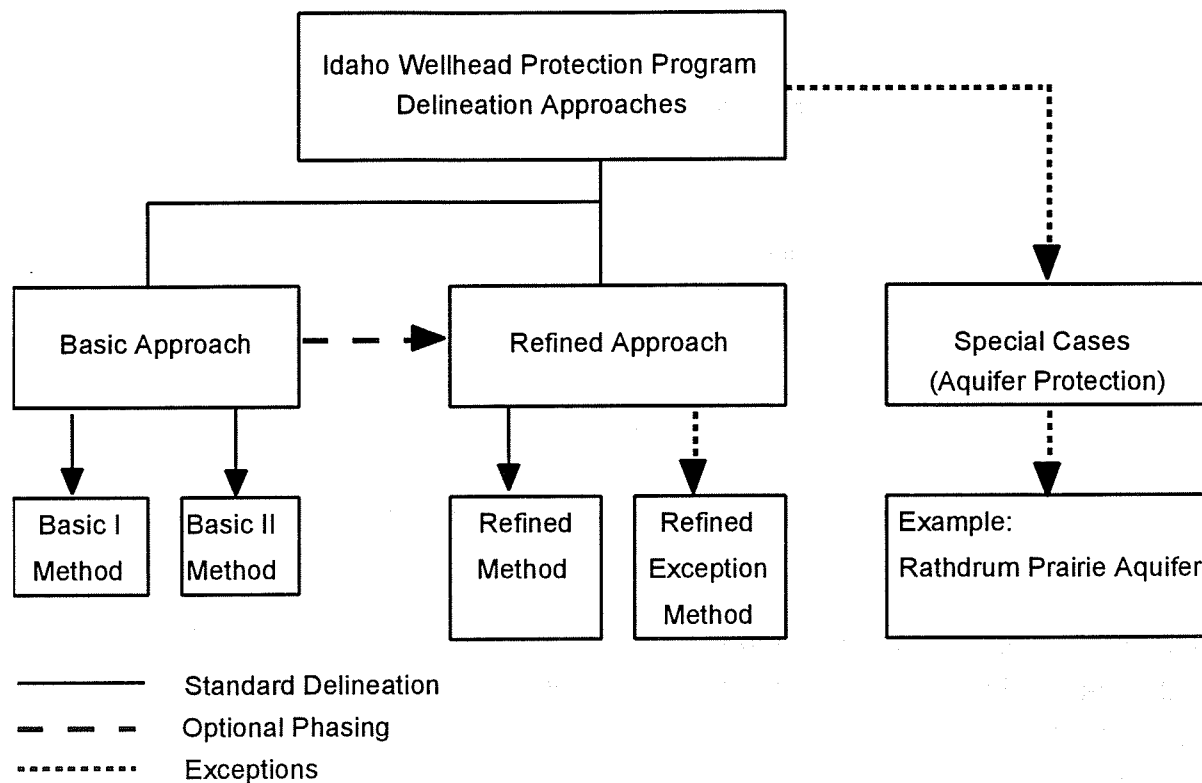
The delineation approaches for Idaho are shown in Figure 4.4. Local governments can choose the delineation approach that best meets their needs and resource availability to implement measures that prevent the contamination of their drinking water supply. An assessment guide has been developed to clarify the intent of these various approaches and will also assist local governments in choosing the most appropriate delineation approach and method (Figure 4.5).

IDEQ anticipates that the smaller communities will use the basic approach and the larger communities will tend to use the refined approach. Communities may choose to phase into the refined approach by first implementing the basic approach. Communities choosing to use the refined approach are not required to first implement the basic approach.

There are two exceptions to the standard delineation guidelines discussed above: the Refined Exception Method and Special Cases (aquifer protection). Communities who choose to utilize these options will need to meet the special conditions that are outlined later in this chapter.

Wellhead protection areas, regardless of the approach or method, are divided into zones that vary in distance from the physical wellhead. The specific details for these zones are discussed in the following sections.

**Figure 4.4 Delineation Approaches for the State Program**

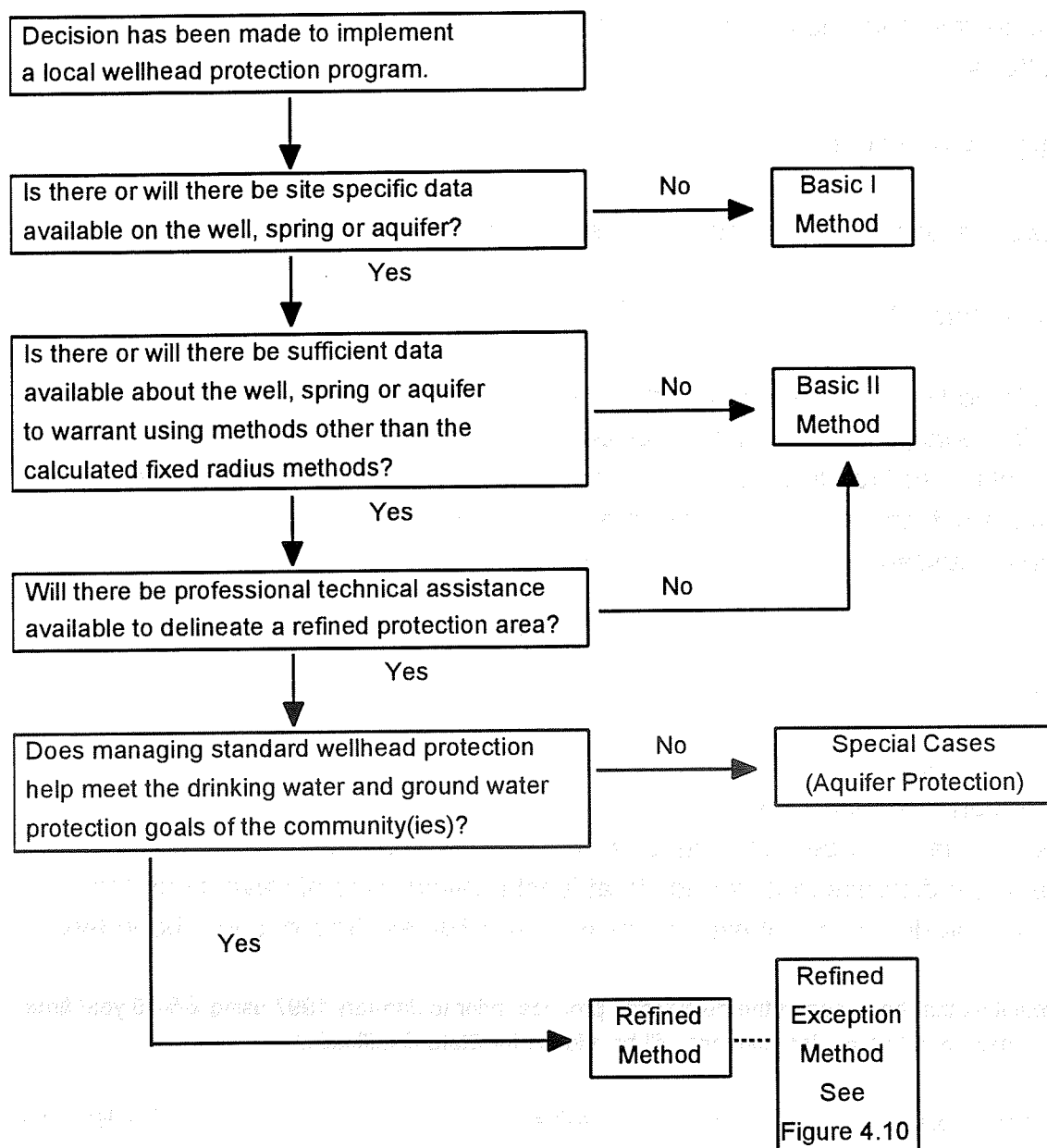


#### 4.5.1.2 Rationale/Discussion

The tiered delineation approach will assist IDEQ in implementing the program as it offers maximum flexibility for program administration and implementation of a voluntary program when there is a wide diversity in system sizes with varying needs. The flexibility of the tiered approach allows communities to choose the delineation method based on whether the approach is appropriate for their water system and on economic considerations.

With the recent increase of monitoring requirements, the financial and administrative responsibilities on drinking water systems has increased significantly. In addition, the bacteria contaminant, monitoring, and reporting violation data for 1992 indicate that most of the infractions have occurred with the small systems, thus wellhead protection is particularly important for this group. This information further substantiates that the Idaho Wellhead Protection Program needs to provide affordable delineation options so that all systems may take advantage of the benefits of the program.

**Figure 4.5. Assessment Guide to Select Appropriate Delineation Method**



Although the level of accuracy of the delineation approaches vary, they all provide a geographic area within which potential sources of contamination can be inventoried and then managed. Since the management component of the program really is the most important part towards actual prevention of contamination, the guideline delineation approaches are justified and help Idaho meet the goals of the program.

The division of wellhead protection areas into zones allows flexibility in the management of potential sources of contamination. Sources that lie in the zones closest to the wellhead need to be managed as stringently as possible. Sources that lie within zones in intermediate distances from the wellhead can be managed less stringently. And finally, sources within the outermost zone should be managed, at a minimum, with public education efforts.

## **4.6 BASIC APPROACH**

There are two methods that comprise the basic approach: Basic I and Basic II.

### **4.6.1 Basic I Method**

The Basic I Method is a fixed radius based on calculations that uses generalized, available, existing hydrogeologic data for the major aquifers in Idaho and the peak sustainable pumping rate of the well (or flow rate of a spring). This method should be used when site specific data are not, and will not be, available. The data and equation used for the Basic I Method are discussed in detail in Appendix F.

Wellhead protection areas defined by the Basic I Method should be zoned as shown by Figure 4.6 and described in Table 4.6 and below:

- ◆ Zone IA: at least the sanitary setback distance for wells and springs as established by the Idaho Rules for Public Drinking Water Systems
- ◆ Zone 1B: the distance that extends to at least a 3-year time of travel boundary
- ◆ Zone II: the distance that extends to at least a 6-year time of travel boundary
- ◆ Zone III: the distance that extends to at least a 10-year time of travel boundary.

NOTE: Communities that have begun the delineation process, prior to January 1997 using 2-5-10 year time of travel boundaries based on earlier guidance will be eligible for State Certification.

The general procedure for delineating the wellhead protection zones using the Basic I Method is outlined in Figure 4.7.

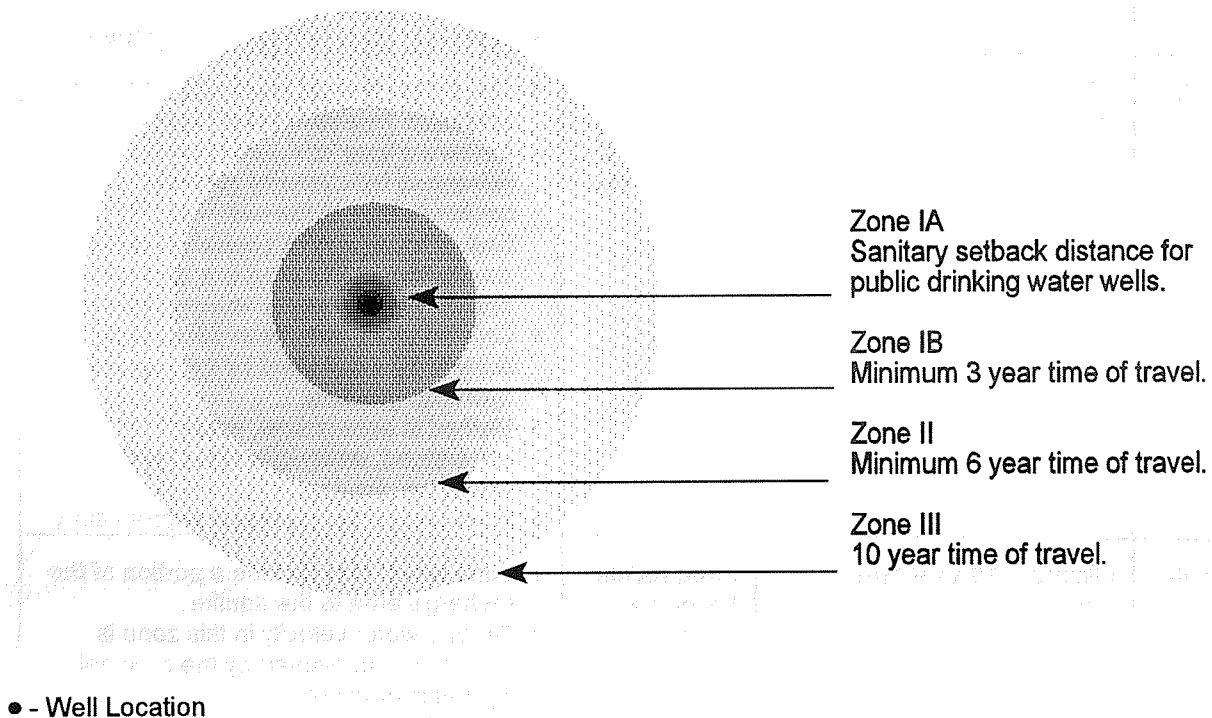
The Basic I time of travel calculations are based on five major hydrogeologic settings in Idaho.

- ◆ Eastern Snake River Plain Basalts
- ◆ Columbia River Basalts
- ◆ Unconsolidated alluvium

- ◆ Mixed volcanic and sedimentary rocks - primarily sedimentary rocks
- ◆ Mixed volcanic and sedimentary rocks - primarily volcanic rocks

The distances for the various time of travel boundaries for pump rates between 50 gallons per minute and 7000 gallons per minute are given in Tables 4.8a through 4.8e. The available data, the rationale for the data selected for calculation, and the method of calculation are discussed in Appendix F.

**Figure 4.6 Wellhead Protection Zones for the Basic I Method**



**Table 4.6 Wellhead Protection Zones Using the Basic I Method**

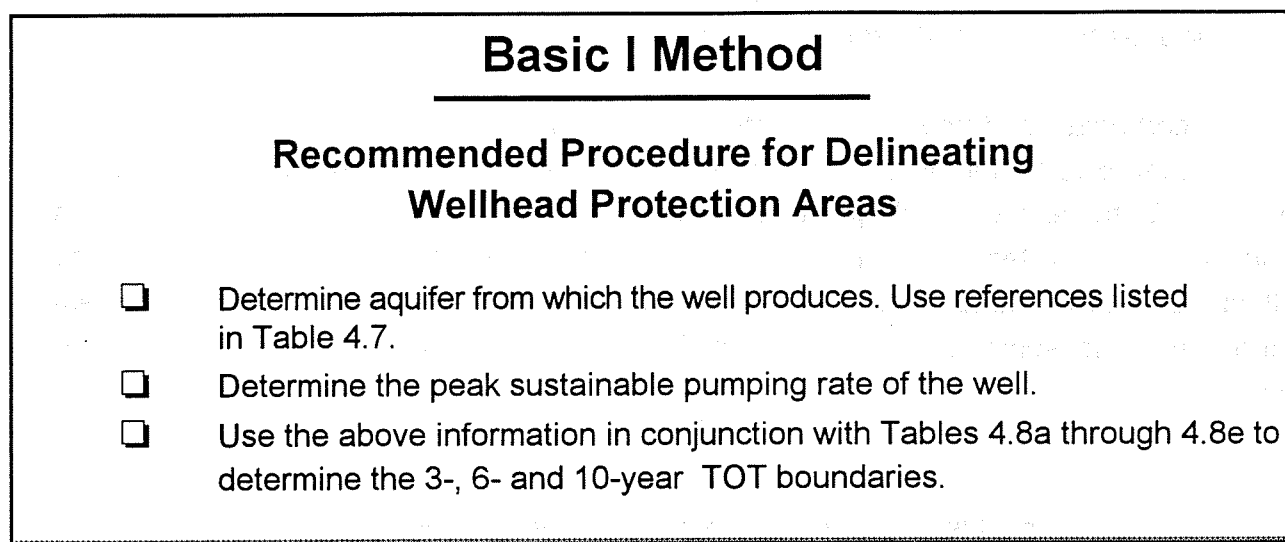
<b>Zone</b>	<b>Zone Boundary</b>	<b>Method(s)</b>	<b>Comments</b>
Zone IA	Sanitary setback distance established in the Idaho Rules for Public Drinking Water Systems.	Fixed radius	<ul style="list-style-type: none"> <li>◆ Distance is consistent with the sanitary setback distance for wells and springs.</li> <li>◆ Zone should be very strictly managed.</li> </ul>
Zone IB	Minimum 3-year time of travel.	Fixed radius based on generalized aquifer data.	<ul style="list-style-type: none"> <li>◆ The 3-year time of travel allows adequate time for a community to develop an interim response<sup>1</sup> to a release or indication of pending contamination at the wellhead. This time of travel is also consistent with a monitoring waiver program, and may assist with monitoring waiver approvals.</li> <li>◆ Ground water velocity in this zone is influenced by the pumping well.</li> <li>◆ Method is economical, easily understood, easily quantified, and useful for phasing.</li> <li>◆ Zone should be stringently managed.</li> </ul>
Zone II	Minimum 6-year time of travel.	Fixed radius based on generalized aquifer data.	<ul style="list-style-type: none"> <li>◆ The 6-year time of travel should allow adequate time for a community to develop a long term solution<sup>2</sup> to a release or indication of pending contamination at the wellhead. This time of travel is also consistent with a monitoring waiver program, and may assist with monitoring waiver approvals.</li> <li>◆ Ground water velocity in this zone is likely to be dominated by the regional hydraulic gradient.</li> <li>◆ Method is economical, easily understood, easily quantified, and useful for phasing.</li> <li>◆ Zone should be managed appropriately.</li> </ul>
Zone III	Minimum 10-year time of travel. <sup>3</sup>	Fixed radius based on generalized aquifer data.	<ul style="list-style-type: none"> <li>◆ Zone which may include a portion of the recharge area to the aquifer.</li> <li>◆ Ground water velocity in this zone is likely to be dominated by the regional hydraulic gradient.</li> <li>◆ Method is economical, easily understood, easily quantified, and useful for phasing.</li> <li>◆ Zone should, at a minimum, be managed with public education efforts.</li> </ul>

<sup>1</sup> Examples: mitigating a contamination problem and providing interim alternative water supplies.

<sup>2</sup> Examples: remediating a contamination problem and finding a long term source of drinking water.

<sup>3</sup> In some cases, this area may need evaluation to ensure that it is within the known area of the aquifer.

**Figure 4.7. Delineation Procedure for the Basic I Method**



Within each of the major hydrogeologic settings, a differentiation between unconfined and confined aquifers has not been made in the calculations, as sufficient data do not exist to determine the degree of confinement or unconfinement. Where multiple aquifers exist, some degree of vertical conductivity should be assumed in all cases.

Figure 4.8 shows the location of the major aquifer types in Idaho. These maps are a compilation of U.S. Geological Survey and Idaho Department of Water Resources (IDWR) publications. The references used for these maps are given in Appendix F.

This map, digitized at 1:500,000, shows only the major aquifers, and can only portray two dimensions. Thus, communities need to use other sources of information to more accurately identify the aquifer that provides the water for their well(s), especially if the well(s) is located at the aquifer boundary (ies). The original purpose of the map was for the administration of ground water rights and to establish the area of communication between ground water and surface water.

For the Wellhead Protection Program, the purpose of this map is to help communities that choose the Basic I Method to:

- ◆ get started, using the map as general guidance;
- ◆ assist them in visualizing where their community lies with respect to the aquifers in the area; and
- ◆ offer a perspective of the diverse hydrogeology in Idaho.

The Technical Task Force recommends that communities should determine the aquifer from which their wells produce by using all of the sources of information available. Suggested resources are shown in Table 4.7.

Granitic, carbonate, metamorphic, and other consolidated rock aquifers exist in Idaho but are considered to be minor aquifers. Basic I wellhead protection areas have not been calculated for these hydrogeologic settings due to a lack of data. IDEQ will evaluate and define wellhead protection areas, on a case-by-case basis, for wells or springs in these settings for those communities that elect to develop a local wellhead protection program using the basic approach. The method that will be used will be determined by the availability of data.

**Table 4.7. Sources of Information to Determine the Producing Aquifer**

<b>Reference Source</b>	<b>Comments</b>
County Planning and Zoning	♦ Aquifer information may be available for comprehensive planning.
Environmental Consultants	♦ Staff has knowledge of aquifers in the state.
Geological Surveys (State and Federal)	♦ Hydrogeologic and geologic reports by the U.S. Geological Survey and Idaho Geological Survey have detailed aquifer information.
Idaho DEQ, Central and Regional Offices	♦ Agency produces hydrogeologic reports. ♦ Staff has knowledge of aquifers in the regional districts and/or state.
Idaho Department of Water Resources	♦ Agency produces hydrogeologic reports. ♦ Well log information resides at the central office. ♦ Staff has knowledge of aquifers in Idaho.
Local well drillers	♦ Local well drillers may have old well logs and general knowledge of an area.
Universities and community colleges	♦ Faculty and students have knowledge of aquifers in Idaho. ♦ Hydrogeologic and geologic reports have detailed aquifer information.

**Table 4.8 Fixed Radii for the Major Aquifers in Idaho**

**Table 4.8a**

Eastern Snake River Plain Basalts										
Zone	Peak Pumping Rate (Gallons per Minute)									
	50 GPM	100 GPM	500 GPM	1000 GPM	2000 GPM	3000 GPM	4000 GPM	5000 GPM	6000 GPM	7000 GPM
Zone IA	Sanitary setback distance									
Zone IB (3 Yr. TOT)	2700'	2700'	3000'	3300'	3700'	4200'	4600'	5000'	5300'	5700'
Zone II (6 Yr. TOT)	5300'	5300'	5600'	5900'	6400'	6900'	7400'	7800'	8200'	8600'
Zone III (10 Yr. TOT)	8800'	8800'	9100'	9500'	10,100'	10,600'	11,100'	11,600'	12,000'	12,500'

TOT = Time of Travel

**Table 4.8b**

Columbia River Basalts										
Zone	Peak Pumping Rate (Gallons per Minute)									
	50 GPM	100 GPM	500 GPM	1000 GPM	2000 GPM	3000 GPM	4000 GPM	5000 GPM	6000 GPM	7000 GPM
Zone IA	Sanitary setback distance									
Zone IB (3 Yr. TOT)	300'	400'	1000'	1500'	2400'	3200'	4100'	4800'	5600'	6400'
Zone II (6 Yr. TOT)	500'	800'	1400'	2000'	3100'	4000'	4800'	5700'	6500'	7300'
Zone III (10 Yr. TOT)	600'	800'	1800'	2600'	3800'	4800'	5700'	6600'	7500'	8300'

**Table 4.8c**

Unconsolidated Alluvium										
Zone	Peak Pumping Rate (Gallons per Minute)									
	50 GPM	100 GPM	500 GPM	1000 GPM	2000 GPM	3000 GPM	4000 GPM	5000 GPM	6000 GPM	7000 GPM
Zone IA	Sanitary setback distance									
Zone IB (3 Yr. TOT)	10,000'	10,000'	10,600'	11,200'	12,300'	13,400'	14,500'	15,600'	16,700'	17,700'
Zone II (6 Yr. TOT)	19,600'	19,700'	20,200'	20,900'	22,100'	23,300'	24,400'	25,500'	26,600'	27,700'
Zone III (10 Yr. TOT)	32,700'	32,800'	33,400'	34,000'	35,300'	36,500'	37,700'	38,800'	40,000'	41,100'

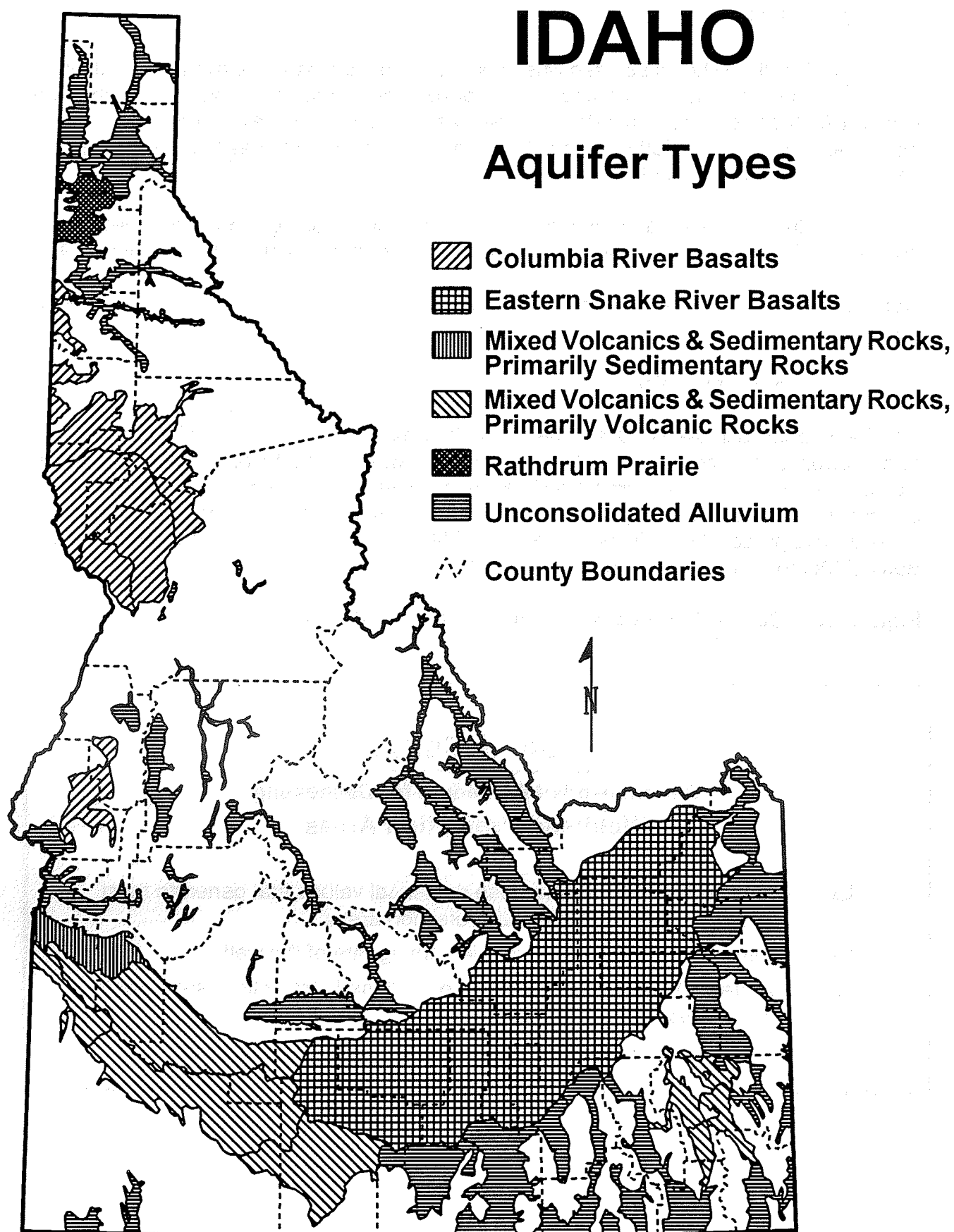
**Table 4.8d**

Mixed Volcanic and Sedimentary Rocks - Primarily Sedimentary Rocks										
Zone	Peak Pumping Rate (Gallons per Minute)									
	50 GPM	100 GPM	500 GPM	1000 GPM	2000 GPM	3000 GPM	4000 GPM	5000 GPM	6000 GPM	7000 GPM
<b>Zone IA</b>	Sanitary setback distance									
<b>Zone IB</b> (3 Yr. TOT)	200'	300'	500'	700'	1100'	1300'	1600'	1800'	2000'	2300'
<b>Zone II</b> (6 Yr. TOT)	300'	400'	800'	1100'	1500'	1800'	2100'	2400'	2600'	2900'
<b>Zone III</b> (10 Yr. TOT)	500'	600'	1000'	1400'	1900'	2300'	2700'	3000'	3300'	3600'

**Table 4.8e**

Mixed Volcanic and Sedimentary Rocks - Primarily Volcanic Rocks										
Zone	Peak Pumping Rate (Gallons per Minute)									
	50 GPM	100 GPM	500 GPM	1000 GPM	2000 GPM	3000 GPM	4000 GPM	5000 GPM	6000 GPM	7000 GPM
<b>Zone IA</b>	Sanitary setback distance									
<b>Zone IB</b> (3 Yr. TOT)	5000'	5000'	5200'	5400'	5700'	6000'	6400'	6700'	7000'	7200'
<b>Zone II</b> (6 Yr. TOT)	9800'	9800'	10,000'	10,200'	10,600'	11,000'	11,300'	11,600'	11,900'	12,300'
<b>Zone III</b> (10 Yr. TOT)	16,400'	16,400'	16,600'	16,800'	17,200'	17,600'	18,000'	18,300'	18,700'	19,000'

Figure 4.8 Map of Major Aquifers in Idaho



#### 4.6.2 Basic II Method

The Basic II Method should be used when some site specific data are available, but when data, technical expertise, and/or funding are not sufficient to use the refined approach. The Basic II Method is more accurate than the Basic I Method, however, it is only a better estimate. The Basic II Method is a calculated fixed radius and uses the same equation used for the Basic I Method.

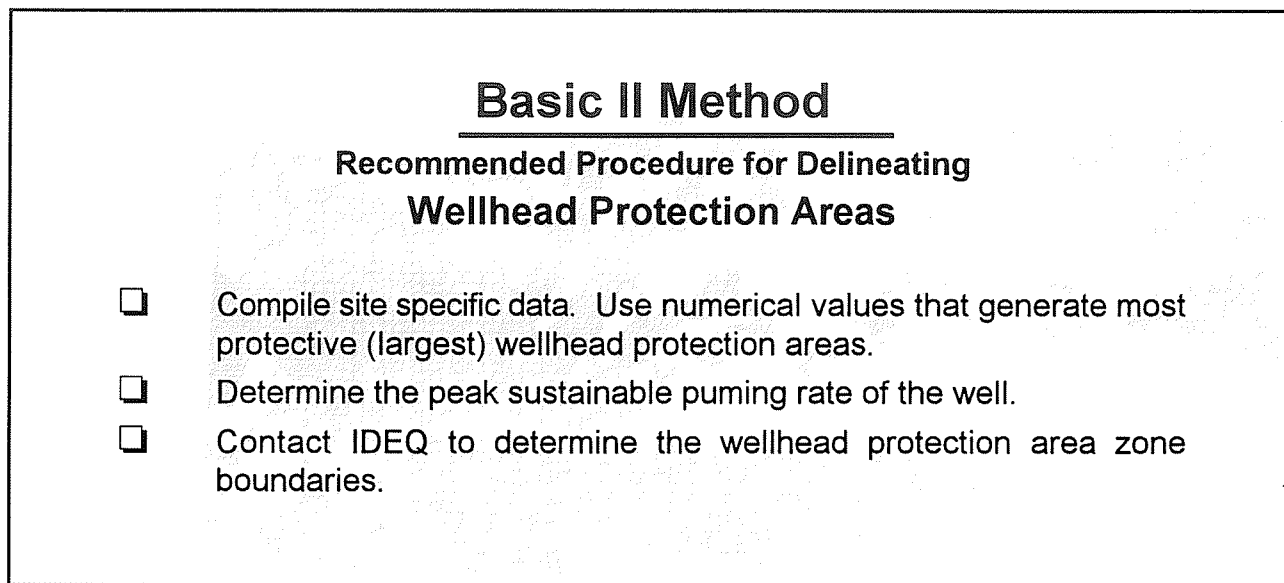
The procedure for delineating wellhead protection areas using the Basic II Method is outlined in Figure 4.9. The guidelines for the zone boundaries are listed in Table 4.9.

Communities that choose this option will need to contact IDEQ to have the calculation performed.

#### 4.6.3 Rationale/Discussion

The basic approach takes advantage of existing data to provide an easily understood, easily applied, low cost wellhead protection area when limited site specific data exist. Communities that use this approach will be made aware of the enhanced benefits of using site specific data and more sophisticated methods. They will be encouraged to phase into the refined approach if initially using the Basic II Method, and will be encouraged to use the Basic II Method if initially using the Basic I Method.

**Figure 4.9 Delineation Procedure for the Basic II Method**



**Table 4.9. Wellhead Protection Zones Using the Basic II Method**

Zone	Zone Boundary	Method(s)	Comments
Zone IA	Sanitary setback distance established in the Idaho Rules for Public Drinking Water Systems.	Fixed radius	<ul style="list-style-type: none"> <li>Distance is consistent with the sanitary setback distance for wells and springs.</li> <li>Zone should be very strictly managed.</li> </ul>
Zone IB	Minimum 3-year time of travel.	Calculated fixed radius using site specific data.	<ul style="list-style-type: none"> <li>The 3-year time of travel allows adequate time for a community to develop an interim response<sup>1</sup> to a release or indication of pending contamination at the wellhead. This time of travel is also consistent with a monitoring waiver program, and may assist with monitoring waiver approvals.</li> <li>Ground water velocity in this zone is influenced by the pumping well.</li> <li>Method is economical, easily understood, and easily quantified.</li> <li>Zone should be stringently managed.</li> </ul>
Zone II	Minimum 6-year time of travel.	Calculated fixed radius using site specific data.	<ul style="list-style-type: none"> <li>The 6-year time of travel should allow adequate time for a community to develop a long term solution<sup>2</sup> to a release or indication of pending contamination at the wellhead. This time of travel is also consistent with a monitoring waiver program, and may assist with monitoring waiver approvals.</li> <li>Ground water velocity in this zone is likely to be dominated by the regional hydraulic gradient.</li> <li>Method is economical, easily understood, easily quantified, and useful for phasing.</li> <li>Zone should be managed appropriately.</li> </ul>
Zone III	Minimum 10-year time of travel. <sup>3</sup>	Calculated fixed radius using site specific data.	<ul style="list-style-type: none"> <li>Zone which may include a portion of the recharge area to the aquifer.</li> <li>Ground water velocity in this zone is likely to be dominated by the regional hydraulic gradient.</li> <li>Method is economical, easily understood, easily quantified, and useful for phasing.</li> <li>Zone should, at a minimum, be managed with public education efforts.</li> </ul>

1 Examples: mitigating a contamination problem and providing interim alternative water supplies.

2 Examples: remediating a contamination problem and finding a long term source of drinking water.

3 In some cases, this area may need evaluation to ensure that it is within the known area of the aquifer.

## 4.7 REFINED APPROACH

There are two methods that are categorized under the refined approach: the Refined Method and the Refined Exception Method. For those communities that choose the refined approach, the method that will most commonly be used is the Refined Method. The Refined Exception Method is to be used only in special cases when the standard wellhead protection area is so large as to be unmanageable.

Water purveyors and/or local governments are responsible for the refined delineation. This delineation should be in cooperation with the community planning team and, if requested, with assistance from IDEQ. This partnership is imperative for the success of the local plan, especially if the water system is not operated by the local government.

Both methods of this approach require the use of site specific data and more sophisticated methods, such as analytical, semi-analytical and numerical modeling, and hydrogeologic mapping. These methods require the assistance and judgement of technical professionals. Obviously, these areas are more accurately defined than the wellhead protection areas using the basic approach. However, the refined approach only offers a better estimation.

Site specific data are data that are unique to the well(s) in the area of interest and are obtained by hydrogeologic investigations, such as aquifer tests, dye tracer tests, and stratigraphic studies. The field method or method of data evaluation to define the numerical value of these data should be determined by technical professionals. However, if there are uncertainties or ranges of values for these parameters, then the value used in the delineation analysis should be the one that yields the most protective (largest) wellhead protection area. The value for well discharge should be the peak sustainable pumping rate of the well.

The type of data needed for the refined approach include:

- ◆ transmissivity;
- ◆ boundary conditions;
- ◆ effective porosity;
- ◆ lithology;
- ◆ regional hydraulic gradient;
- ◆ storativity;
- ◆ hydraulic conductivity;
- ◆ degree of confinement;
- ◆ aquifer saturated thickness; and
- ◆ recharge area.

A technical guidance document developed by the EPA, "Model Assessment for Delineating Wellhead Protection Areas," EPA 440/6-88-002, provides possible ground water flow and contaminant transport models that might be used. The EPA has also developed a modular, semi-analytical ground water flow model, WHPA Code 2.2, which is designed specifically to delineate capture zones. This model is applicable to homogeneous aquifers that exhibit two dimensional, steady state ground water flow.

#### **4.7.1 Refined Method Zones**

Wellhead protection areas using the Refined Method are zoned using the guidelines shown in Table 4.10. It is anticipated that most of the larger communities will use this method as more accurate wellhead protection areas will be desired to protect the ground water resource.

The delineation analysis should be the one that yields the most protective (largest) wellhead protection area. The value for well discharge should be the peak sustainable pumping rate of the well.

**Table 4.10. Wellhead Protection Zones Using the Refined Method**

Zone	Zone Boundary	Method(s)	Comments
Zone IA	Sanitary setback distance established in the Idaho Rules for Public Drinking Water Systems.	Fixed radius	<ul style="list-style-type: none"> <li>Distance is consistent with the sanitary setback distance for wells and springs.</li> <li>Zone should be very strictly managed.</li> </ul>
Zone IB	Minimum 3-year time of travel.	Hydrogeologic mapping, semi-analytical, analytical, or numerical modelling using site specific data.	<ul style="list-style-type: none"> <li>The 3-year time of travel allows adequate time for a community to develop an interim response<sup>1</sup> to a release or indication of pending contamination at the wellhead. This time of travel is also consistent with a monitoring waiver program, and may assist with monitoring waiver approvals.</li> <li>Ground water velocity in this zone is influenced by the pumping well.</li> <li>Methods should incorporate actual conditions and can be used to refine the basic approach.</li> <li>Zone should be stringently managed.</li> </ul>
Zone II	Minimum 6-year time of travel.	Hydrogeologic mapping, semi-analytical, analytical, or numerical modelling using site specific data.	<ul style="list-style-type: none"> <li>The 6-year time of travel should allow adequate time for a community to develop a long term solution<sup>2</sup> to a release or indication of pending contamination at the wellhead. This time of travel is also consistent with a monitoring waiver program, and may assist with monitoring waiver approvals.</li> <li>Ground water velocity in this zone is likely to be dominated by the regional hydraulic gradient.</li> <li>Methods should incorporate actual conditions and can be used to refine the basic approach.</li> <li>Zone should be managed appropriately.</li> </ul>
Zone III	Minimum 10-year time of travel. <sup>3</sup>	Hydrogeologic mapping, semi-analytical, analytical, or numerical modelling using site specific data.	<ul style="list-style-type: none"> <li>Zone which may include a portion of the recharge area to the aquifer.</li> <li>Ground water velocity in this zone is likely to be dominated by the regional hydraulic gradient.</li> <li>Methods should incorporate actual conditions and can be used to refine the basic approach.</li> <li>Zone should, at a minimum, be managed with public education efforts.</li> </ul>
Recharge Areas and Flow Boundaries	Recharge areas and flow boundaries	Hydrogeologic mapping.	<ul style="list-style-type: none"> <li>Concern is primarily for vertical recharge, but should also include horizontal recharge.</li> <li>Method should incorporate actual conditions.</li> <li>Zone should be managed appropriately.</li> </ul>

<sup>1</sup> Examples: mitigating a contamination problem and providing interim alternative water supplies.

<sup>2</sup> Examples: remediating a contamination problem and finding a long term source of drinking water.

<sup>3</sup> In some cases, this area may need evaluation to ensure that it is within the known area of the aquifer.

#### 4.7.2 Refined Exception Method Zones

The Refined Exception Method is a special case of the refined approach. This method should only be used if it can be demonstrated that the combined zones (Zone IB, II, III) of the standard Refined Method are so large as to be unmanageable and if the community can demonstrate that they can effectively manage the potential sources of contamination in a smaller wellhead protection area. Figure 4.10 shows the assessment process to determine the appropriate use of the Refined Exception Method.

The zone boundaries for this method are listed in Table 4.11.

**Figure 4.10 Assessment for Appropriate Use of the Refined Exception Method**

<h2 style="text-align: center;"><u>Assessment</u></h2> <h3 style="text-align: center;">Refined Exception Method</h3>	
All answers must be "yes" to use this method.	
<input type="checkbox"/> Yes <input type="checkbox"/> No	Is the size of the standard refined wellhead protection area so large as to be unmanageable?
<input type="checkbox"/> Yes <input type="checkbox"/> No	Can the community adopt and effectively enforce prevention measures to protect the smaller wellhead protection area?
<input type="checkbox"/> Yes <input type="checkbox"/> No	Can the community demonstrate that it can clean up spills and respond to threats within a 3 year time period?
<input type="checkbox"/> Yes <input type="checkbox"/> No	Are there contingency plans to obtain alternative water supplies or install acceptable treatment technology within a 3 year time period if needed.
<input type="checkbox"/> Yes <input type="checkbox"/> No	Has the community contacted IDEQ of their intent to use this method?

**Table 4.11. Wellhead Protection Zones Using the Refined Exception Method**

Zone	Zone Boundary	Method(s)	Comments
Zone IA	Sanitary setback distance established in the Idaho Rules for Public Drinking Water Systems.	Fixed radius	♦ Distance is consistent with the sanitary setback distance for wells and springs.
Zone IB	Minimum 3-year time of travel.	Hydrogeologic mapping, semi-analytical, analytical, or numerical modeling using site specific data.	♦ The 3-year time of travel allows adequate time for a community to develop an interim response <sup>1</sup> to a release or indication of pending contamination at the wellhead. This time of travel is also consistent with a monitoring waiver program, and may assist with monitoring waiver approvals. ♦ Ground water velocity in this zone is influenced by the pumping well. ♦ Methods should incorporate actual conditions and can be used to refine the basic approach.
Zone II	Recharge areas and flow boundaries.	Hydrogeologic mapping.	♦ Concern is primarily for vertical recharge but should also include horizontal recharge. ♦ Method should incorporate actual conditions.

<sup>1</sup>Examples: mitigating a contamination problem and providing interim alternative water supplies.

### 4.7.3 Rationale/Discussion

The refined approach provides an alternative for those communities who desire more accurate delineations of their wellhead protection areas such that more specific and comprehensive management of the area can be applied. Also, communities that start with the basic approach may phase into the refined approach as the need arises and resources become available.

The Refined Exception Method, which is a special case, was included as a delineation option because there may be some communities with extremely large wellhead protection areas, but have very strong management and response programs. In these cases, it may be better to manage effectively a smaller area than to poorly manage a large area. Communities that intend to use the Refined Exception Method will need to meet certain conditions which are listed in Figure 4.10. One of the most important conditions established is the ability of the community to manage the smaller wellhead protection area more stringently.

## 4.8 SPECIAL CASES OF WELLHEAD PROTECTION

Special cases of wellhead protection will be approved for certification by IDEQ and if needed, the Technical Task Force will be consulted. The appropriate conditions to use this approach are outlined in Figure 4.11.

Special cases of wellhead protection should be considered for reasons such as attributes of an aquifer or to increase the effectiveness of management strategies. In some cases, such as the Rathdrum Prairie Aquifer, the ground water velocity within the aquifer is very high such that the ground water would best be protected using the aquifer protection approach. In other cases, ground water protection may simply be more effective if two or more political entities cooperatively managed an aquifer or a portion of an aquifer.

**Figure 4.11. Assessment for Appropriate Use of the Special Case Approach**

<b>Assessment</b>	
<b>Special Cases (Aquifer Protection)</b>	
All answers must be "yes" to use this method.	
<input type="checkbox"/> Yes <input type="checkbox"/> No	Does aquifer protection more closely meet the goals of the community(ies) for drinking water and ground water protection?
<input type="checkbox"/> Yes <input type="checkbox"/> No	Has the aquifer been sufficiently studied to establish hydrologic boundaries?
<input type="checkbox"/> Yes <input type="checkbox"/> No	Are there coordination mechanisms in place to assist the community(ies) in managing the larger protection area?
<input type="checkbox"/> Yes <input type="checkbox"/> No	Have the coordinating entities contacted IDEQ of their intent to use this method?

### 4.8.1 A Special Case Example: Rathdrum Prairie Aquifer

The Rathdrum Prairie Aquifer, located in northern Idaho, was deposited during flooding from glacial Lake Missoula during the Great Ice Age, approximately 14,000 years ago. It is composed of sand and gravel, fine to coarse, poorly to moderately sorted, with scattered

cobbles and boulders. The calculated values of ground water velocity in these sediments are high and vary between 41.1 - 90.5 feet/day. (U.S. Geological Survey, 1978).

The aquifer is cooperatively managed by the Coeur d'Alene Regional Office of IDEQ, the Panhandle District Health Department, Kootenai County, communities on the aquifer, and the State of Washington. The aquifer management effort has been ongoing since the late 1970s.

Wellhead protection areas on the Rathdrum Prairie Aquifer were modeled by the Coeur d'Alene Regional Office of IDEQ. It was found that the individual wellhead protection areas were very narrow because of the high transmissivities and extended from the wellhead to the closest major recharge area. The Technical Task Force concurred with the managing entities that aquifer management was the most appropriate method and has developed special wellhead protection delineation guidelines shown in Table 4.12. The development of different delineation guidelines for the Rathdrum Prairie Aquifer is not directly related to its status as a Sole Source Aquifer or additional protective criteria existing within Idaho rules.

**Table 4.12. Zones for the Rathdrum Prairie Aquifer**

Zone	Zone Boundary	Method(s)	Comments
Zone I	Sanitary setback distance established in the Idaho Rules for Public Drinking Water Systems.  Minimum distance of 300 feet for wetted recharge zones <sup>1</sup> .	Fixed radius	<ul style="list-style-type: none"> <li>◆ Distance is consistent with the sanitary setback distance for wells and springs.</li> <li>◆ The 300 foot setback distance is consistent with the setback distance requirement from surface water in the "Individual and Subsurface Sewage Disposal Regulations."</li> <li>◆ Method is economical, easily understood, and easily quantified.</li> </ul>
Zone II	Aquifer boundary as established by EPA, February 1978.	Hydrogeologic mapping.	
Zone III	Critical aquifer recharge areas <sup>2</sup> .	Hydrogeologic mapping.	

1 "Wetted recharge zones" refer to the terminal ends of streams that infiltrate high volumes of water directly to the Rathdrum Prairie Aquifer. These areas directly link surface water with the aquifer and exist as outfalls for Hauser Creek, Rathdrum Creek, Spirit Lake, Hayden Lake, and several other streams (Division of Environmental Quality, 1991). They are very vulnerable to contamination from surface activities because they exhibit saturated flow conditions during certain times of the year (Sutherland, 1992).

2 "Critical aquifer recharge areas" refer to recharge areas outside the formal aquifer boundaries (Division of Environmental Quality, 1991). The definition of a critical aquifer recharge area includes:

- ◆ surface watersheds that drain directly into the Rathdrum Prairie Aquifer without flowing through a lake;
- ◆ lake watersheds where the lake discharge is exclusively to the Rathdrum Prairie Aquifer, including Spirit Lake, Twin Lakes, Hauser Lake, and Hayden Lake; and
- ◆ aquifers that discharge directly into the main Rathdrum Prairie Aquifer. These areas have been limited to outlets that discharge directly to the aquifer and have no other water outlet. There are 19 areas identified as critical aquifer recharge areas.

#### **4.8.2 Rationale/Discussion**

This option was developed because there may be situations in which aquifer protection is more relevant to achieving the goals of the wellhead protection program than managing individual wellhead protection areas. A coordinated management effort will be needed to effectively manage an aquifer or portion of an aquifer.

### **4.9 WELLHEAD PROTECTION AREA DELINEATION AND PUMPING RATE CHANGE**

The delineation of a wellhead protection area should be reevaluated when there is a change, either an increase or decrease, in pumping rate or water right of the well.

#### **4.9.1 Rationale/Discussion**

Defining wellhead protection areas will take into consideration the peak sustainable pumping rate in gallons per minute of the well. Often times, however, the pumping rate or water right of a well will be changed to meet a different water demand. When there is a change of the pumping rate or water right, the delineation of the wellhead protection area should be reevaluated because the well pump rate may affect the size of the wellhead protection area.

### **4.10 WELLHEAD PROTECTION AREAS FOR WELLFIELDS**

If the area of contribution of wells overlap and the basic approach (Basic I or Basic II Method) is used, then the wellhead protection area should be defined by combining the wellhead protection areas of those wells (Figure 4.13). The combined wellhead protection areas are called a wellfield protection area. If the refined delineation approach is used, the wellfield protection area can be defined by using a computer modeling program.

#### **4.10.1 Rationale/Discussion**

A wellfield protection area will be easier to manage than individual overlapping wellhead protection areas.

### **4.11 WELLHEAD PROTECTION AREA BOUNDARY ADOPTION**

Wellhead protection area boundaries should be adopted by the appropriate entity(ies).

If a community determines that it will need to manage a multi-jurisdictional wellhead protection area(s), the local wellhead protection plan should include the mechanism of coordination or criteria of the pending mechanism of coordination in an appendix to the plan (Reference, Community Planning Teams in Chapter 3).

#### **4.11.1 Rationale/Discussion**

Many wellhead protection areas in Idaho are anticipated to include land within the jurisdiction of multiple governmental entities. All governmental entities will need to work cooperatively to effectively manage these areas.

Mechanisms to manage multijurisdictional wellhead protection areas may include:

- ◆ letter of agreements and
- ◆ memorandums of understanding.

Also, if there is a legal agreement between the entities, ordinances and local comprehensive plans can then be used to manage these areas.

#### **4.12 WELLHEAD PROTECTION AREA INFORMATION TO BE SUBMITTED TO THE STATE**

Information on wellhead protection area boundaries should be submitted to IDEQ on a detailed map. This map should show the sources of contamination within the wellhead protection area boundaries. The recommended map scales are:

Zone IA: Scale of 1:300

Zone IB: Scale of 1:300

Zone II: Scale of 1:24,000 (7.5 minute quadrangle)

Zone III: Scale of 1:24,000 unless the zone is very distant, then use 1:100,000

The IDEQ may help develop these maps if requested.

#### **4.12.1 Rationale/Discussion**

The Technical Task Force recommended that wellhead protection boundary information be submitted at these map scales because the scales are appropriate for the sizes of the individual zones. Also, maps at these scales are commonly used and readily available.

**Figure 4.12 Wellfield Concept Using the Basic I Method**

